SUBSURFACE CONTAMINANTS FOCUS AREA TECHNICAL ASSISTANCE TEAM

to

DEPARTMENT OF ENERGY ALBUQUERQUE OPERATION OFFICE

SANDIA NATIONAL LABORATORY

BASELINE OPTIONS FOR KIRTLAND AREA OFFICE WITH EMPHASIS ON MANAGING PCBs AND CHARACTERIZING AND ASSESSING SUBSURFACE CONTAMINATION

Background

The Albuquerque Operations Office Environmental Restoration Division Director, Mr. George Rael, in late June of this year, requested the Subsurface Contaminants Focus Area perform a technical Baseline Review. The technical Baseline Review was to be conducted on selected environmental restoration projects at the Sandia National Laboratory to develop Baseline options, with emphasis on managing PCBs and characterizing and assessing subsurface contamination. These projects fall under the purview of the DOE Kirtland Area Office for oversight and management. The original request for a technical Baseline Review included the following:

- Chemical Waste Landfill – The treatment and off-site disposal options for soils with PCBs and soils with both PCBs and tritium.

- Corrective Action Management Unit – Treatment and containment options for soils with PCBs and other contaminants.

- Technical Areas 1 & 2 – The characterization and assessment of groundwater and vadose zone strategies.

- Mixed Waste Landfill – Assess treatment and disposal strategies for large volumes of soil containing mixed waste. Also, examine the risk management analysis and review cover options.

The primary point of contact for this work was Mr. Dave Bourne, DOE-KAO. Albuquerque Operations Office wanted a review completed in time for their rebaseline meeting, which was to be held in early August. It was agreed that the Lead Laboratory Technical Team would perform the reviews the week of July 23, 2000, and provide a draft outline of a Letter Report to the Albuquerque Operations Office and Kirtland Area Office at the Team out-visit. Because of the very short turnaround time, AL and the SCFA Lead Laboratory agreed on a phased approach, with the first review concentrating on the groundwater/vadose projects at TAs 1&2 and the PCB problems at the Chemical Waste Landfill and CAMU storage issue. The remaining projects would be reviewed at a later date. The SCFA Lead Laboratory Manager assembled a team that represented the following institutions: LLNL, LANL, SRTC, INEEL, LBNL, ANL, ORNL, PNNL and WPI. Briefings were held on July 24,2000, on the issue of PCB treatment and disposal. Principle presenters were Scott Schrader and David R. Miller from Sandia. On July 25, 2000, briefings were provided by Sue Collins from Sandia, and John Gould from DOE-KAO on groundwater issues related to TAs 1&2. This Letter Report reflects the thoughts and suggestions of the technical Baseline Review Team. There are two sections of this report containing the Team's comments that address the two respective technical areas, and a third section that contains general programmatic comments dealing with overarching issues.

SECTION I

SANDIA CHEMICAL WASTE LANDFILL

Objective and Problem Definition

The team provided technical input related to soil treatment processes that may be used to meet waste acceptance criteria for VOCs and PCBs for disposal of soil from the Sandia Chemical Waste Landfill (CWL).

The following information and assumptions were considered.

- The primary focus is on establishing a process that will reduce VOCs to levels acceptable for disposal in the Corrective Action Management Unit (CAMU).

- Metals will be treated/stabilized by a process already planned and permitted.

- The CAMU can currently accept soil containing PCBs at concentrations less than 50 ppm.

- Unless off-site disposal without treatment is used, permits or permit modifications will be required.

- According to Sandia personnel, the permit process can be accomplished in six to eight months. Disposal of PCBs above 50 ppm in the CAMU is possible, and is likely to receive a favorable response from EPA and NMED, but the concept may encounter significant public concern. (If less than 50 ppm, a TSCA permit will not be required for disposal of soil in the CAMU).

- The degree of difficulty in obtaining permits will likely decrease if PCB levels in soil are expected to be reduced below 50 ppm and/or dioxin and furan are not produced as part of the treatment process.

- If disposal of soil with moisture containing tritium above 20,000 pCi/L is to occur in the CAMU, a permit modification will be required. However, site technical personnel believe such a modification will be relatively easy to obtain and expect that additional sampling combined with continued decline of tritium values in stored soil will eliminate this as a problem. Some uncertainty still exists. Because the tritium is assayed by evaluating the concentration in the associated pore water rather than the total amount per gram of soil, it will not decline significantly in a 1 year time scale even if a large fraction evaporates or is drawn off by active ventilation in a managed storage approach. If, however, some make-up water is added during managed storage to promote biological degradation, then there should also be a major decrease in tritium concentration as well as total amount. Alternately, the site could try to get the method of assay changed to agree with the approach used almost universally elsewhere for other radionuclides by calculating the amount in terms of pCi/gm of soil. However, this would require regulatory concurrence and, because of this, may present difficulties.

- The current estimate of soil volume contaminated with PCBs is estimated to be a maximum of 8,500 cubic yards. However, some uncertainty still exists. The cost of off-site disposal of this soil is estimated to be $54 million.

- The off-site disposal costs include off-site treatment prior to disposal. It is possible that if soil is required to be disposed off-site, on-site treatment prior to shipment may provide a cost saving.

- Off-site disposal requirements may be more stringent than CAMU requirements.

- Site logistics and space are a concern for treatment processes.

Discussion

The approach to providing technical input on these issues is to supplement what appears to be a very competent technical effort currently being implemented by the Sandia team. An intelligent, proactive approach is currently being used in the site decision-making.

Outlined below are successful treatment technologies for PCBs:

Extraction Technologies: .	**Destruction Technologies:**
Chemical - Solution Extraction	**Chemical/Biological** - Biological Remediation - Chemical oxidation with Biological Remediation
Thermal - Thermal Desorption with condensation	**Thermal** - Molten Aluminum - Thermal Desorption with Catalytic Destruction

- Extraction technologies remove the organic compounds into a condensed, secondary waste stream which will require destruction or disposal off-site. It is possible that the TSCA incinerator will accept these waste streams for destruction at no additional cost to the site.
- Destruction technologies destroy the contaminants, typically with minimal secondary waste streams.

Issues

The important issues related to these two broad categories of treatment technologies can be organized into categories. These categories are important ones for the site to consider in developing their baseline technologies.

Category	Important Issues
Technical Risks	– Maturity of process – Technical considerations specific to process
Health and Safety	– Special concerns specific to process, such as flammable or hazardous solvents, high temperatures, moving machinery, etc.
Long-term Stewardship/Liability	– Ability to reduce PCB and VOC concentrations to extremely low levels
Ability to Permit	– Relative ease of permitting – related to emissions, byproducts, regulatory acceptance, etc.
Schedule	– Can the process be implemented within a year? – Can treatment be completed in an additional year?
Cost	– General comments on what is known about the unit costs of the treatment process.
Other	– How easily can residuals be stabilized? – Will the process allow off-site disposal criteria to be met?

Technical Risks

- High temperature processes (above 400 degrees Celsius) will increase the production of dioxins and furans in addition to volatilizing more mercury. These concerns would have to be addressed in an appropriate off-gas control system.

- Thermal desorption with condensation or catalytic destruction, solvent extraction, and bioremediation are relatively more mature processes.

- Bioremediation with chemical oxidation, molten aluminum, and Commodore processes are less mature.

- A better understanding must be acquired concerning the byproducts resulting from the Commodore process.

Health and Safety

- Thermal desorption (both kinds) and molten aluminum use high temperatures.
- Thermal desorption (both kinds) use rotating mechanical equipment.
- Solvent extraction may use flammable solvents.
- Chemical oxidation uses oxidizing compounds.
- The Commodore process uses ammonia and elemental sodium.
- Bioremediation presents the fewest health and safety risks.

Long-term Stewardship/Liability

- Thermal desorption (both kinds), solvent extraction, and molten aluminum reduce VOCs and PCBs to very low levels resulting in lower long-term liabilities.
- Bioremediation (with and without chemical oxidation) may not remove PCBs to levels below 50 ppm. Bioremediation typically removes only 80 to 90% of organic contaminants, although the remaining fraction is generally less mobile (more easily stabilized) than the removed fraction.
- Uncertainty exists concerning the Commodore process as to the long-term consequences of intermediate long chain hydrocarbons and currently unregulated compounds.

Ability to Permit

- The thermal desorption options appear relatively easy to permit since this option with catalytic destruction is already approved for the site. Changing to the condensing option should be favored by regulators.
- Both kinds of bioremediation should be relatively easy to permit and be publicly acceptable. Fugitive emissions may be a concern.
- Solvent extraction and the Commodore process should be relatively easy to permit.
- Molten aluminum may meet regulatory resistance for its similarity to incineration.

Schedule

All alternatives except molten aluminum and Commodore appear implementable in stated time-frame because of the uncertainty associated with it being a less mature technology.

Cost

There is a wide range of costs for these technologies. However, bioremediation options are generally much more cost effective than the other processes. Sandia technical personnel maintain reservations about the potential for extended bioremediation processes to negatively impact schedule and possibly inhibit site logistics, although they expressed that this may be because they have not had the opportunity to become familiar with this type of technology.

Other Issues

- All of the alternatives appear to meet more stringent off-site disposal requirements except bioremediation techniques. Some outstanding questions remain about the Commodore process.

- In most cases, residuals are easily stabilized. Some outstanding questions remain about the Commodore process.

- Other Resources available as evaluation and selection proceed.
  - Lead Lab
  - ITRD
  - TechCon

Recommendations

The technologies examined above are acceptable processes for use at Sandia. The most effective way to proceed is to determine the most cost effective, life cycle process for Sandia using an RFP with carefully detailed terms and conditions that the process has to meet. The framework used to examine the technologies discussed above was designed to facilitate the procurement process by creating categories for procurement evaluation criteria (e.g., technical risk, cost, ability to permit, etc.).

The RFP should include a first article testing phase to assure Sandia, the regulators, and the stakeholders that the selected process will meet all parts of the RFP before proceeding to treat the waste. The rigor of the testing phase should depend on the degree of maturity of the process. More mature processes may be able to demonstrate the likelihood for success at Sandia by presenting information from other similar deployments of their technology. Less mature technologies may have to employ more intensive field demonstrations to verify that their technologies can be successfully deployed at Sandia. Preparation of the RFP will allow Sandia to effectively describe the conditions that will be acceptable to the regulators, stakeholders, and DOE prior to proceeding.

It is clear that the time required to implement a full-scale treatment process on-site could easily take one year. Recognizing that the biological chemical activity of the existing excavated soil is not static, "enhanced storage" should be considered.

Enhanced storage means encouraging the degradation of VOCs and PCBs and the evaporation of tritium in soil water by implementing simple engineering features in the stored soils (e.g., aerating them and possibly adding water to enhance microbial growth).

Advantages:

- Lower levels of contaminants into ultimate treatment endpoint.
- Some soil may not require additional treatment.
- Tritium management facilitated.

It is likely that the regulatory agencies will view this as treatment and negotiations may be required, as well as control of releases to the atmosphere.

SECTION II

SANDIA NATIONAL LABORATORY GROUND WATER REMEDIATION PROGRAM

Overall Strategy

Deliver the Site to Long Term Stewardship with minimum long-term liabilities (presumed to be the desired end state)

The judgment of the Team is that the current program is well thought out and well executed. We make the following observations recognizing that we had limited review time. Some of the items recommended may already be in place.

We view that there are some threats to achieving the desired end state of entering a stewardship mode with a minimum of long-term liabilities. The following comments and recommendations are intended to address these threats.

Sue Collins led an excellent tour of the Site. She, John Gould, and others also briefed the team on both technical and stakeholder issues, with perhaps an emphasis on the northern portion of the site. We consider this to be appropriate because of the proximity to off-site population and water users.

Recommendations

<u>Develop and validate defendable conceptual contaminant fate and transport models:</u>
This is necessary for several reasons – a conceptual model with explicitly stated assumptions and predictions will help highlight data gaps and can be tested with new data. It will also serve as a tool for communications with stakeholders, regulators, and other groups. It also serves as a platform on which to base discussions of remedial options.

- We believe that the most likely option for the observed TCE in the perched ground water will be some sort of natural attenuation: Acceptance of natural attenuation should be based on:
  - Demonstration that TCE source(s) are now controlled.
  - Evidence that contaminant concentrations are decreasing with time.
  - Vadose characterization at Sandia North. This may exist in the form of shallow seismic reflection and hydro-geologic cross sections constructed from well logs and cores, but we saw very little.
  - Comprehensive soil gas gridding (~ 500 ft c/c) at Sandia North should go a long way toward demonstrating the presence or absence of TCE source areas. The area covered should extend to the DOE property boundaries and also include the Kirtland AFB sewage lagoon and its supply line if possible.
  - Demonstration of biodegradation breakdown products – these could be determined in ground water samples as well as in the soil gas.

<u>Source issues need to be addressed without regard to property boundaries.</u>
- This might require that DOE offer to extend soil gas surveys onto DoD property.
- Identification of all potential sources:
  - Characterization of suspect potential sources, particularly in the vadose zone.
  - If source areas are identified, source control can be achieved with active and/or passive soil vapor extraction.

<u>Provide good quality, highly communicative data presentations to interested parties; e.g., flow paths, trends, etc.:</u>
Data presentation in the few reports we viewed could be improved. For example:
- the concept of the stratigraphic support for perching water was presented as little more than a cartoon;
- 3-D block diagrams could probably be produced for some areas; and
- water level and contaminant data for wells were graphed with different time scales and could not readily be compared.

<u>Use uncertainty analyses and sensitivity analyses to help identify key data needs.</u>

<u>The overall strategy should be mapped onto:</u>
- Conceptual model – as noted above, this model can serve as a basis for predicting the consequences of various actions
- Specific site actions and characterizations
- Reduce frequency of sampling and number of analytes tested for; e.g.:
  - Cost Effective Sampling Algorithm (LLNL)
  - Explore use of TCE sensors

  - Review NM Environmental Department guidance for reduction of frequency and number of analytes
  - Use tritium and TCE hits as guides to the need for a more extensive suite of analytes

<u>Data Management and Integration</u>

- It is not apparent to the Team that there is an integrated approach. The Site would benefit from a centralized database operated by the ground water monitoring group for the benefit of all SNL customers. Several of us are familiar with the system at SRS in which all well installation, sampling, analysis, and data management are handled by a section of the Environmental Protection Department. Raw data and maps are available to any interested party with access to Site computers. A copy of the database can be maintained outside of a firewall for off-site users.
- A site-wide integrated environmental database coupled with state-of-the-art interpretation and display tools will also address the data management needs required for long term stewardship.

<u>Interface Management could be improved</u>

- Communications with neighbors, nearby community, Indian Nation(s), Regulators.
- Build and share technical database among KAFB, City of Albuquerque, and SNL:
  - Integrate Kirtland AFB and SNL information and data. For example, there is not enough information regarding the sewage lagoon
  - Need to agree upon data interface management
- The concept of a Community Action Board (CAB) is viewed as valuable. Get the CAB involved in the approach to help develop ownership:
  - They must have equal footing
  - Must be attentive and responsive to community concerns
- Have clear Data Quality Objectives established when dealing with NMED
- As a mechanism to involve other parties in planning, consider the "Technical Planning Process" developed by the US Army Core of Engineers (Kansas City Branch) and facilitated by Black and Veatch. This is a formal, facilitated, three-day approach
- Examine potential cooperative programs with stakeholders, regulators, USGS, and New Mexico State Engineer to generate and share data such as regional water level measurements made at the same time.

<u>Continue the existing voluntary sampling program with the following suggested modifications:</u>

- Annual sampling as appropriate based on analysis of historical data
- Eliminate testing for analytes with persistent "non detects"
- Reduce frequency of sampling and number of analytes
  - Cost Effective Sampling Algorithm (LLNL)
  - Explore use of TCE sensors
  - Review NM Environmental Department guidance for reduction of frequency and number of analytes
  - Use tritium, TCE, and possibly nitrate hits as guides to the need for a more extensive suite of analytes
- Address metals sampling with high flow samplers

  - Agree on test protocols in advance with NMED
- Both filtered and non-filtered sample pairs should be used to reduce uncertainty associated with risk

SECTION III
PROGRAMMATIC ISSUES

General Comments

Based on the information provided by the Kirtland Area Office, it is the consensus of the Team that the remediation approaches used at the Chemical Waste Landfill and for groundwater are both reasonable and sound. The following suggestions and comments are offered for consideration to help enhance or improve those efforts already planned or underway.

Groundwater Data Management and Integration

- It is not apparent to the Team that there is an integrated approach. The Site would benefit from a centralized database operated by the ground water monitoring group for the benefit of all SNL customers. Several of us are familiar with systems in which all well installation, sampling, analysis, and data management are handled by a single group or section such as the Environmental Protection Department at SRS. Raw data and maps are available to any interested party with access to Site computers. A copy of the database can be maintained outside of a firewall for off-site users.
- A site-wide integrated environmental database coupled with state-of-the-art interpretation and display tools will also address the data management needs required for long term stewardship.

Interface Management

- Improved communications with neighbors, nearby community, Indian Nation(s), Regulators.
- Build and share technical database among KAFB, City of Albuquerque, and SNL:
  - Integrate Kirtland AFB and SNL information and data. For example, there is not enough information regarding the sewage lagoon
  - Need to agree upon data interface management
- The concept of a Citizens Advisory Board (CAB) is viewed as valuable. Get the CAB involved in the approach to help develop ownership:
  - They must have equal footing
  - Must be attentive and responsive to community concerns
- The KAO is pursuing a Monitored Natural Attenuation (NMA) strategy for its groundwater program. This approach is based on the fact that no high concentrations of contaminants have been discovered thus far in the vadose zone or groundwater through its site characterization efforts. Most contamination observed has been in relatively low concentrations, perhaps several times the maximum allowable concentration limits. It is the opinion of the Team, however, that KAO should lead this strategy with a very strong posture with regard to site characterization. Based on available data, the Team suggests additional work is needed to put forth a formidable argument for MNA. The CAB and regulators must feel comfortable with the conclusions drawn from a reasonable subset of soil and

groundwater data that supports the conceptual model. Data gaps appear to exist near the boundaries between potential off-site source terms and Sandia Technical Areas.

- Examine potential cooperative programs with neighbor problem holders, stakeholders, regulators, USGS, and New Mexico State Engineer to generate and share data such as regional water level measurements made at the same time. Such programs offer opportunities to build working relationships as well as leverage resources. Pooled resources could be an economical way to fill in data gaps in areas where such data are beneficial to all participating parties. This would be appropriate for soil-gas surveys and the construction of monitoring wells and characterization borings.
- Have clear Data Quality Objectives established when dealing with NMED
- As a mechanism to involve other parties in planning, consider the "Technical Planning Process" developed by the US Army Core of Engineers (Kansas City Branch) and facilitated by Black and Veatch. This is a formal, facilitated, three-day approach

Sampling Protocols

It was pointed out in the discussions that NMED has not ruled on the use of low-flow pumps versus conventional sampling protocol. KAO has taken the initiative to conduct a voluntary sampling and testing program using low-flow sampling techniques. The KAO has accumulated an extraordinary amount of groundwater sampling data at the risk that the regulator may not accept the data once they formally enter into the regulatory permit phase. KAO may want to consider parallel sampling for a period of time to demonstrate a comparison in the data set using the two methods. Such comparisons could be used to successfully argue the presence of chromium as a constituent of concern or as an artifact of a sampling methodology and/or well construction material degradation.

Additional Technical Assistance

The Subsurface Contaminants Focus Area (SCFA) has at DOE-AL disposal, additional resources in the area of technical assistance. The SCFA Lead Lab can make available to the DOE-AL Office and to its stakeholders/CAB independent technical reviewers in the areas of soil and groundwater. The subject matter experts can be accessed to assist in technical consultation that is completely divested from DOE, and therefore can be impartial and objective in their review. Other resources available through the SCFA is the ITRD program. This program brings with it a proven effective process to help problem holders identify the best technologies to address their remediation problems. Working in tandem with ITRD is the TechCon program. It is also available to help the problem holder determine what technologies are available in the private sector that could potentially be a solution. Information on these programs are available through the SCFA or on the respective program web sites.

Appendix

SANDIA TECHNICAL ASSISTANCE TEAM

Name	Affiliation	Area of Expertise
David L. Eaton	Idaho National Engineering and Environmental Laboratory	Regulatory Issues
John C. Evans, Ph.D.	Pacific Northwest National Laboratory	Characterization and remediation of subsurface environmental contamination
Terry C. Hazen, Ph.D.	Lawrence Berkeley National Laboratory	Environmental microbiology; bioremediation
Tom Hicks, M.S., P.G.	DOE—Savannah River	Geology, hydrogeology
David Janecky, Ph.D.	Los Alamos National Laboratory	Geochemistry; contaminant fate and transport
Michael I. Morris	Oak Ridge National Laboratory	Radioactive and hazardous waste management.
Van Price, Ph.D.	TRW/Waste Policy Institute	Geology, geophysics, and geochemistry
Paul W. Reimus, Ph.D.	Los Alamos National Laboratory	Contaminant/tracer transport in saturated systems
Robert Starr, Ph.D., P.E.	Idaho National Engineering and Environmental Laboratory	Fate and transport of contaminants
Richard J. Woodward, Ph.D., P.E.	Lawrence Livermore National Laboratory	Geotechnical Engineering, Environmental Engineering

TECHNICAL TEAM QUALIFICATIONS

David L. Eaton, Idaho National Engineering and Environmental Laboratory

John C. Evans, Battelle, Pacific Northwest National Laboratory

Dr. Evans is trained as a nuclear chemist and works as an environmental chemist at PNNL in the Field Hydrology and Chemistry Group. He has been employed at PNNL for the past 23 years. His current research centers around methods for characterization and remediation of subsurface environmental contamination. Recent activities have included in situ destruction of TCE by Redox manipulation and the use of advanced characterization techniques including soil gas analysis and stable isotope fingerprinting. Other major recent research activities have centered around characterization of components of the vapor headspace in Hanford nuclear waste tanks. Past research activities included: cosmic ray produced radionuclides in lunar samples and meteorites; solar neutrino detection; double-beta decay detection; nuclear reactor decommissioning; source term characterization of effluents from coal, oil shale, and geothermal energy use. Prior to joining PNNL, he worked for six years as a staff chemist in the Brookhaven National Laboratory Department of Chemistry. He holds a Ph.D. in chemistry from the University of California, San Diego and a B.S. in chemistry from Florida State University.

Terry C. Hazen, Lawrence Berkeley National Laboratory
Dr. Hazen received his B.S. and M.S. degrees in Interdepartmental Biology from Michigan State University. His Ph.D. is from Wake Forest University in Microbial Ecology. His dissertation research was done at the DOE Savannah River Site on the effects of nuclear reactor cooling waters on bacteria, alligators and fish. Dr. Hazen was Professor, Chairman of Biology and Director of Graduate Studies at the University of Puerto Rico for 8 years. He was Fellow Scientist at the Savannah River Site 11 years, the last 5 as manager of the Biotechnology Group within the Savannah River Technology Center. In early 1998, Dr. Hazen joined the LBNL Earth Sciences Division as Head of the Microbial Ecology and Environmental Engineering Department and Lead Scientist for the Environmental Remediation Technology Program. Since September 1999 he has also been head of the Center for Environmental Biotechnology. He is a fellow of the American Academy of Microbiology and has authored more than 149 scientific publications, not including more than 341 abstracts and chapters in several books. He has also given more than 580 scientific presentations, 75% of them invited. Dr. Hazen received the 1995 R&D 100 Award, 1996 R&D 100 Award, and the 1996 Federal Laboratory Consortium Excellence in Technology Transfer for bioremediation technologies. He has patents on 5 bioremediation processes that are being used in 15 states; these technologies have been licensed to more than 30 companies. Dr. Hazen has acted as an expert reviewer for 25 different scientific journals and 14 federal research granting agencies. He has supervised and consulted on the implementation of bioremediation at more than 50 sites. He is currently the LBNL representative to the DOE EM50 Strategic Lab Council, the DOE Natural and Accelerated Bioremediation Research Program Field Research Center, the EM50 Subsurface Contaminant Focus Area Lead Lab POC, and the EM50 lead for LBNL. He was recently appointed to the United Nations Global Water Quality Task Force, one of only two US scientists. His area of specialty is environmental microbiology, especially as it relates to bioremediation. His current research is focused on aerobic bioremediation of landfills, PAH contaminated soil, solvent contaminated soil and groundwater, and actinide biogeochemistry.

Tom Hicks, P.G., DOE—Savannah River
Tom Hicks has B.S. and M.S. degrees in geology with a minor in civil engineering from North Carolina State University. Tom has 29 collective years of professional experience in the areas of environmental restoration, domestic and foreign nuclear power plant and defense waste processing facility siting and foundation investigations, and civil and military project management. He is currently serving as the DOE Technical Team Lead for the Subsurface Contaminants Focus Area (SCFA) hosted at the Savannah River Operations Office in Aiken, South Carolina. SCFA is one of five Focus Area programs managed by the DOE Headquarters Office of Science and Technology. SCFA is responsible for the science and research in support of DOE soil and ground-water cleanup activities and the development and deployment of innovative technologies that provide solutions to DOE subsurface environmental problems. Mr. Hicks is responsible for the technical aspects of the SCFA, including serving as the DOE liaison to the SCFA Lead Laboratory, a Savannah River Technology Center (SRTC)–based organization that is in partnership with the national laboratories to provide technical assistance to the DOE weapons complex facilities utilizing the expertise from the national labs, the private sector, and universities.

David Janecky, Los Alamos National Laboratory

Dr. Janecky received a Ph.D. in geology from the University of Minnesota. He also studied at Stanford University, University of California at Berkeley, University of California at Santa Barbara, and the University of Bergen, Norway. Dr. Janecky's research interests include the geochemistry of aqueous transport and reaction processes with specific focus on actinide geochemistry, geologic waste isolation systems, contaminant transport and containment, hydrogeochemistry, petroleum reservoir systems, hydrothermal metamorphism, and ore deposits. Dr. Janecky has been on the staff at the Los Alamos National Laboratory since 1984. His present job activities and responsibilities include serving as project leader for the Environmental Science and Technology Program Office, conducting research in actinide geochemistry modeling, Waste Isolation Pilot Plant (WIPP) repository backfill reaction investigations, and pore scale modeling of geochemical processes. Dr. Janecky also serves on the Rocky Flats ETS Actinide Migration Advisory Panel and on the Transuranic Waste Certification Project at Los Alamos.

Michael I. Morris, UT-Battelle, ORNL Oak Ridge TN
Michael I. Morris is a development staff member in the Chemical Technology Division of Oak Ridge National Laboratory (ORNL) specializing in project management for implementation of demonstrations of innovative technologies for treatment of mixed wastes that have no identified methods of treatment. He is also the chairman of the Mercury Working Group (HgWG) under DOE's Mixed Waste Focus Area. The HgWG is responsible for soliciting, identifying, initiating, and managing efforts required to address the technical treatment deficiencies associated with DOE's Mercury-contaminated mixed wastes. Morris also is affiliated with the Center of Life Cycle Cost Analysis (LCCA) at ORNL working as a program and project manager. The Center conducts multidisciplinary research in order to define real-world solutions to environmental challenges. Morris is a graduate of Northwestern University with a degree in chemical engineering. He has over 30 years of multifaceted experience in petroleum processing and radioactive and hazardous waste management. His professional experience includes starting up and trouble shooting petroleum refinery processes, radioactive, hazardous and mixed wastes treatment process development and design, and project management of multi-plant waste treatment technology demonstrations.

Van Price, TRW/WPI
Dr. Price is currently a member of the technical support team for the SCFA. He holds a Ph.D. in Geochemistry from the University of North Carolina. He has over 30 years of experience including college teaching and administration, mineral and oil exploration research for Gulf Oil Corporation, and at the DOE Savannah River Laboratory/SRTC, including an assignment as Manager of the SRS Ground Water Monitoring Program during 1991-93. His expertise is in geology, geophysics, and geochemistry, and he is the author of numerous technical papers and abstracts.

Paul W. Reimus, Los Alamos National Laboratory
Dr. Reimus has been employed as a staff member at Los Alamos National Laboratory since 1989. Prior to that he was employed at Battelle Pacific Northwest Laboratories (1983-1989). He received his Ph.D. in Chemical Engineering from the University of New Mexico in 1995. He also holds B.S. and M.S. degrees in Chemical Engineering. His Ph.D. dissertation research involved studying colloid transport through laboratory-scale fractures in volcanic rocks. Dr. Reimus has been a principal investigator for saturated zone transport testing activities for the

Yucca Mountain Site Characterization Project (YMP) for the past 5 years and for the Nevada Test Site Underground Test Area project for the past 3 years. During that time he has directly supervised four field tracer tests at the Nevada Test Site. He has also been associated with four other field tracer tests since 1995, including one conducted in a shallow alluvial aquifer in Albuquerque's South Valley. In addition to field testing activities, Dr. Reimus has conducted many different types of laboratory experiments to study contaminant or tracer transport in saturated systems (batch sorption experiments, diffusion cell experiments, and column transport tests). He has also developed several mathematical models/computer codes to aid in interpreting both field and laboratory transport experiments.

Robert C. Starr, P.E., Bechtel BWXT Idaho, LLC
Dr. Starr is employed as a hydrogeologist at INEEL. His main activities are related to remediation of ground-water contamination caused by historical waste disposal practices at DOE sites and at other Superfund sites. His professional interests include developing and applying subsurface characterization and remediation techniques. At INEEL, he has evaluated the use of in situ chemical oxidation, zero-valent metals, and monolithic confinement for remediating contaminated ground water near a well formerly used for injecting wastes into the subsurface. Prior to joining INEEL, he worked five years as a researcher at the Waterloo Centre for Groundwater Research, where he was involved in research related to DNAPL remediation, low-permeability cutoff walls for contaminant source containment, and permeable in situ reactors and funnel-and-gate systems for plume remediation. He holds both Ph.D. and M.S. degrees in earth sciences (with specialization in contaminant hydrogeology) from the University of Waterloo and a B.S. in civil engineering from the Georgia Institute of Technology. During his graduate studies, he investigated the correlation between labile organic carbon and the occurrence of denitrification in the vadose and ground water zones and solute transport in dual porosity media.

Richard J. Woodward, P.E., Lawrence Livermore National Laboratory
Dr. Woodward is a Civil Engineer, responsible for project planning and coordination of activities in the Environmental Restoration Division at LLNL. He is responsible for coordinating development of the annual Multi-Year Work Plans, the Baseline Plan and the Long Term Stewardship Plans using activity based costing in the Phoenix project management system. He is also responsible for coordinating the implementation of performance measures for the twenty-plus subprojects in ERD, where over forty plumes of contaminated ground water are being actively treated by a variety of facilities and methods. Prior to joining LLNL two years ago, Dr. Woodward worked as a consultant for 13 years in the field of Geotechnical Engineering and for 20 years in the field of Environmental Engineering. He was responsible for major geotechnical engineering aspects of large dams, bridges, nuclear power plants and buildings. He was also responsible for important design and construction aspects of commercial hazardous waste disposal facilities and for the evaluation and remediation of contaminated soil and ground water projects throughout the United States. He holds both a Ph.D. and M.S. degrees in Civil Engineering from the University of California and a B.C.E. degree from the University of Santa Clara.